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Modular Classrooms

California Building Energy Efficiency Standards
Revisions for July 2003 Adoption

MODULAR CLASSROOMS

Description

Modular Classrooms (MCR's) represent a unique opportunity for improving the energy efficiency of non-residential buildings in California. Currently about 10,000 modular classrooms are built annually in California by a group of less than twenty manufacturers. MCR's are factory-built with modest attention to energy efficiency. Windows are typically single glazed, lighting is largely T12 fluorescent, insulation levels are moderate, and equipment efficiencies are typically at minimum levels. The factory setting is also conducive to minimizing incremental cost for preferred energy efficiency measures from both a volume purchase viewpoint and the opportunity to standardize installation labor.
Premium MCR's, which incorporate cost-effective efficiency measures, represent a targeted opportunity for increasing the energy efficiency of new non-residential buildings in California. The major goal of this effort is to develop packages of measures (either a single statewide package or climate zone or region-specific packages) which meet prescribed economic criteria. The package would apply to MCR's only.

Benefits

Improved energy efficiency of MCR's would favorably impact annual energy use and peak load. Inefficient lighting contributes to high internal gains resulting in high cooling energy use and peak demand. Improved equipment efficiencies and envelope thermal performance would also contribute to reduced loads. A secondary benefit of the premium MCR is substitution of low E^2 glazing for the standard gray tinted glazing found in many MCR's. Improved daylighting has been shown to be beneficial in classroom applications.
TDV would offer increased benefit for this initiative as reductions in on-peak consumption would likely be greater than during off-peak periods.

Environmental Impact

Premium MCR's would have favorable environmental impacts due to the reduction in energy use and associated atmospheric emissions. Indoor air quality may be improved in these premium MCR's. There are no negative environmental impacts associated with this initiative.

Type of Change

Implementation of this measure is likely to be a Prescriptive Requirement. Due to the fairly standardized nature of MCR's in terms of layout and design, a Prescriptive package appears to be the best approach for implementation. This would deviate from current non-residential Title 24 practice where MCR compliance is demonstrated via computer modelling. The Non-residential Standards, compliance manuals, and compliance forms would need to be modified to accommodate this "Package" compliance approach.

Measure Availability and Cost

There are currently less than 20 manufacturers of MCR's in California simplifying market transformation activities. The energy efficiency measures likely to be installed are all currently available from various suppliers and therefore pose no availability issues. The measures include T8 lighting with electronic ballasts and specular reflectors, added insulation, radiant barrier (or cool roof), high performance glazing, and improved heat pump efficiency. There are no commissioning or performance verification issues since the measures are fairly common to the building industry.
Cost effectiveness should be compared to current construction practice, which is fairly uniform throughout the industry. Since the ultimate client for the premium MCR are the local school districts, payback time horizons can be longer than for typical non-residential customers.

Useful Life, Persistence and Maintenance

There are no issues related to the lifetime of individual measures nor the energy savings persistence. A premium MCR with lower space conditioning loads may in fact exhibit longer equipment life due to the reduced runtime on the unit. Maintenance intervals or no different than for standard MCR's, although replacement costs (e.g. broken windows, T8 lamps) may be slightly higher. Operating cost savings for the premium MCR's will dwarf any incremental maintenance costs.

Performance Verification

There are no performance verification issues related to premium MCR's.

Cost Effectiveness

The premium MCR will demonstrate a cost-effective package of measures. Which measures are implemented will be dictated by the cost-effectiveness criteria, the performance analysis, and the incremental cost data.

Analysis Tools

DOE-2 will be used to simulate performance of the standard and premium MCR's. Simulation runs will be used to assemble the cost-effective package of measures.

Bibliography and Other Research

Davis Energy Group has completed two studies of Premium MCR's for PG&E. (*Premium Efficient Relocatable Classroom Performance Assessment in PG&E Territory*, 2000 and *Energy Analysis and Review of Modular Classrooms,* 1997).

Element 6 of LBNL's Programmatic PIER project "*High Performance Commercial Building Systems*" evaluated high performance MCR's.

Danny Parker of FSEC has also been involved in improving the energy efficiency of MCR's.